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A Late Bathonian morphoceratid (Jurassic, Ammonitina) from Peru

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With 1 plate and 2 figures in the text

Abstract

The Yura Group of Quebrada de Quentos in southern Peru has yielded a small ammonite fauna of *Epistrenoceras* and *Choffatia* cf. *acuticosta* documenting the Upper Bathonian, together with rare (?)Morphoceratidae n. gen. et sp. The globose shell of at least one of the two specimens has constricted, densely costate, inner whorls with nodose umbilical edge, resembling the outer whorls of *Morphoceras*; absence of ventral smooth band is as in *Asphinctites*, i.e., latest known morphoceratids. Known stratigraphic and biogeographic distributions of Morphoceratidae are probably extended from the Late Bajocian-Early Bathonian of West Tethys (Spain to Iran; and possibly *Pseudoneuqueniceras* from Late Bathonian of Japan), to the Late Bathonian of the Andes.

Kurzfassung

Vom südlichen Peru wird eine kleine Ammonitenfauna des Oberbathoniums beschrieben, die neben *Epistrenoceras* und *Choffatia* cf. *acuticosta* auch zwei Exemplare von bislang unbekannten, wahrscheinlichen Morphoceratidae n. gen. et sp. enthält. Die Innenwindungen der relativ großen Form entsprechen im Querschnitt, Berippung und Einschnürungen *Morphoceras* s. stricto, haben aber keine ventrale Rippenunterbrechung, ähnlich wie bei der letzten bisher bekannten morphoceratiden Gattung *Asphinctites*. Die biostratigraphische und biogeographische Verbreitung der Morphoceratidae wird daher wahrscheinlich vom Oberbajocium bis Unterbathonium des westlichen Tethysbereiches bis zum Oberbathonium in den Anden vergrößert.

Introduction

The Middle Jurassic ammonite biostratigraphy and biochronology of the Andes have been reasonably well established, especially for the Southern Andes of northern Chile and central Argentina, but are less well known for the Central Andes (summarized by Riccardi et al., 1992; Hillebrandt et al., 1992). The Bathonian ammonite fauna is partly endemic, belonging to the East Pacific Subrealm that was fully developed at this time and characterized by Eurycephalitinae, and the stage is usually incompletely developed. Important Tethyan elements

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from these Bathonian ammonite faunas have recently been described from northern Chile by GRÖSCHKE & HILLEBRANDT (1994). The small, lowermost assemblage includes *Cadomites*, *Iniskinites* and, significantly, ?*Zigzagiceras*, i.e. potentially the first Andean evidence of Early Bathonian; the Mid-Bathonian *Rugiferites sofanus* assemblage, also with *Iniskinites* and ?*Cadomites* as well as *R. sofanus* (BOEHM) which is known from the Middle Bathonian of Indonesia and probably Neuquén, Argentina; and the diverse (mainly) Late Bathonian *Epistrenoceras – Choffatia jupiter* assemblage, which includes *Lilloettia*, *Parapatoceras*, and the rare Tethyan ammonite *Hemigarantia*. Curiously, a very similar ammonite fauna is present in Mexico (SANDOVAL et al., 1989).

The Ammonitina family Morphoceratidae is well known from the uppermost Bajocian and, especially, the Lower Bathonian of Europe, Iran and Northwest Africa, i.e., thriving in the Submediterranean Province of the West Tethyan Subrealm (reviewed by SANDOVAL, 1983). A single specimen of the late morphoceratid genus *Asphinctites* has also been recorded *ex situ* from the Sula Islands, Indonesia (WESTERMANN & CALLOMON, 1988, plate 18, figs. 4a, b). Clade appearance and disappearance are both abrupt so that the global record of the family is obviously incomplete. Hence, clade origin and extinction on a world-wide scale are unknown (WESTERMANN, 1993). The first recognition of a post-Early Bathonian possible morphoceratid was by RICCARDI et al. (1991), i.e., „*Neuqueniceras*" *yokoyamai* (KOBAYASHI & FUKUDA) in Hokkaido, Japan, which they designated as the type species of *Pseudoneuqueniceras*. In the thick and fossiliferous clastic sequence of the Kaizara Formation on the Hida Terrane, the *yokoyamai* Assemblage Zone is directly superposed by the basal Callovian *Kepplerites japonicus* Assemblage Zone, so that the *yokoyamai* Zone is dated quite securely as Late-to latest Bathonian (SATO, 1992, table 9.5). Significantly, morphoceratids in North Africa that co-occur with *Epistrenoceras* and *Hemigarantia* have tentatively been dated as Early Bathonian (S. ELMI, pers. comm. 1994). However, Late Bathonian appears to be more plausible because both associated genera are good indices for the Retrocostatum Standardzone. The specimens here described constitute the second record of Late Bathonian probable morphoceratids.

Stratigraphy

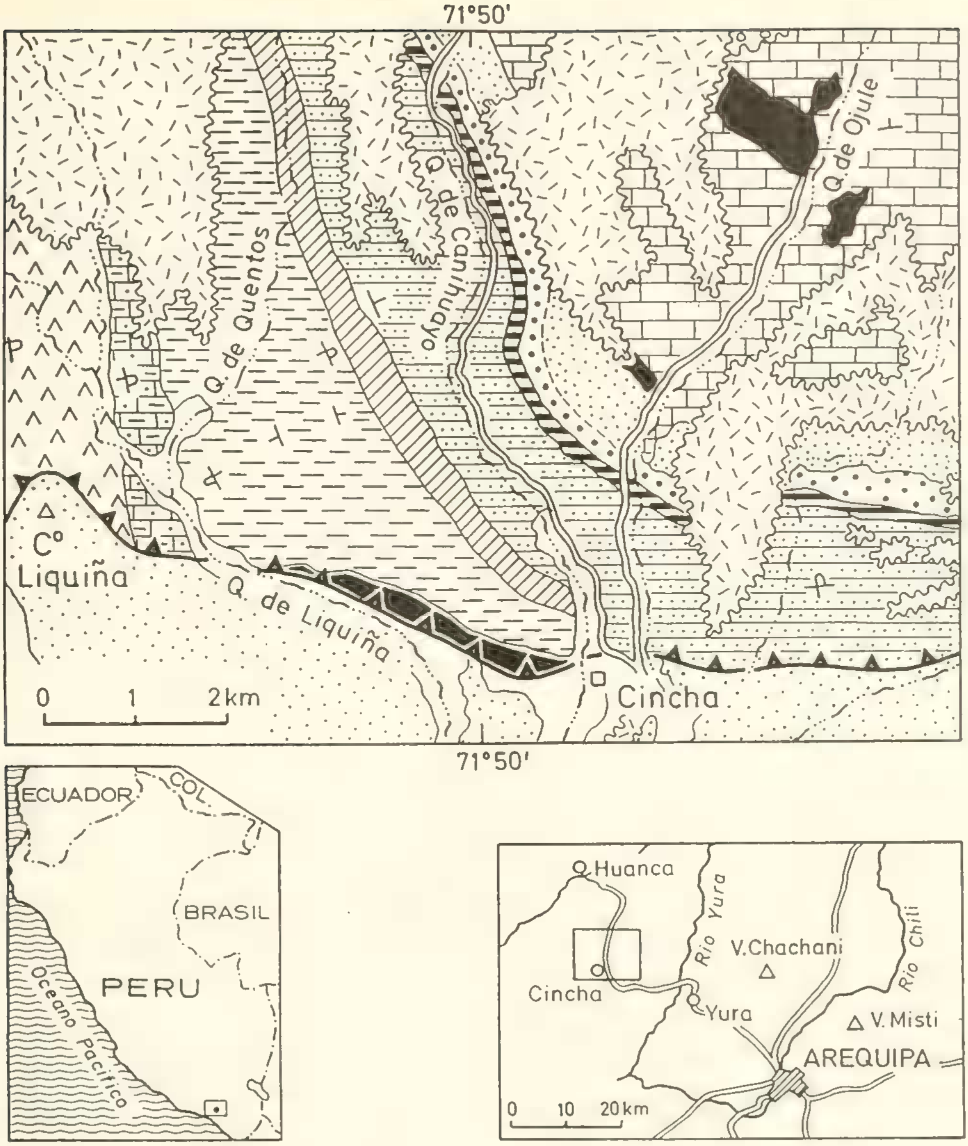
Fossil Locality

Section Aquada de Liquiña - Quebrada de Quentos

In southern Peru (Fig. 1), volcanics of the Chocolate Formation, Yura Group, are capped by a 0.5 m bed of breccias and conglomerates with calcareous matrix, containing up to 4 cm clasts of the Chocolate Formation. Superposed are 0.5 m limestone and another calcareous conglomerate with Chocolate clasts. This sequence is partly overturned and folded, making it impossible to reconstruct a precise stratigraphic section. VICENTE (1991) places these beds at the base of the Socosani Formation, which he estimates to become 240 m thick in Lluta sequence.

These basal beds of the Socosani Formation are followed by 2–3 m of dm-bedded limestones with cocquina and crushed rhynchonellid and terebratulid brachiopods. There follows a thick succession of medium-bedded echinoderm cocquinas with lutitic-arenaceous interbeds which, 5–10 m above the Chocolate Formation, have yielded poorly preserved *Dactylioceras*, *Hildatites* and *Peronoceras* of the Lower and Middle Toarcian. On this lies a c. 10 m sequence of green sandstones, partly with volcanic clasts and belemnite fragments.

The upper Socosani Formation consists of 150–200 m thin-bedded lutites. In the lower part are thin limestone beds and concretion levels with ammonites. One of the lowest levels



GEOLOGIC FORMATIONS

Chocolate - Early Juras.	Hualhuani - Early Cret.
Socosani - Toarc./Bath.	Murco - Early Cret.
Puente - Callovian	Arcurquina - Alb./ Cenom.
Cachios - ?Callovian	Chilcane - Santonian
Labra - L. Jur./E. Cret.	Huanca - Oligocene
Gramadal - Early Cret.	Tacaza Group - Miocene

Text-fig. 1. Topographic map of outcrop area (after VICENTE et al., 1979)

(790401/3) has yielded ammonites of the Singularis Zone (Early Bajocian), whereas other levels (790401/4a, b, c) in this interval (but not necessarily in that sequence) yielded ammonites of the lower Giebeli or Singularis Zones. Much higher in the Socosani occur several layers with large calcareous concretions, up to 1 m in diameter, which contain rare Late Bathonian ammonites, including the new genus described below. Approximately 20-40 m higher begins the sandstone sequence of the Puente Formation.

Ammonite Faunas

The rare and generally poorly preserved fossils found in the section include the following ammonoid assemblages (from top), which permit identification of only the Early Bajocian Singularis and/or Giebeli Zones, the Late Bathonian (with probable Morphoceratidae n. gen. et sp., here referrred to as „*Morphoceras*"), and the Early Callovian Bodenbenderi or Proximum Zones (for Andean standard zones see RICCARDI et al., 1989).

1. 20-40 m above „*Morphoceras*" beds

790401/6 — One body-chamber fragment of *Rehmannia* (*Rehmannina*) cf. *douvillei* (STEINMANN) ♂ (microconch) — known from Bodenbenderi and Proximum Zones (higher Lower Callovian, c. Gracilis Zone) of northern Chile (RICCARDI & WESTERMANN, 1991).

2. „*Morphoceras*" beds

790401/5 — Two complete specimens of (?)Morphoceratidae n. gen. et sp. (described below); one fragment of *Epistrenoceras* sp.; one small (?) body-chamber (D=31mm) of *Choffatia* (*Homoeoplanulites*) cf. *acuticosta* (J. ROEMER) ♂ . The latter species, together with the closely affiliated *C. aequalis* (J. R.), *C. pseudoperspicua* (STEPH.) and *C. sparsicostata* (WEST.), are known from the Late Bathonian Retrocostatum Zone of Europe, extending from France to the Kaukasus (WESTERMANN, 1958; STEPHANOV, 1972; HAHN et al., 1990). Rare, similar forms with poor preservation probably occure also in the Steinmanni Zone of northern Chile and Neuquén Province, Argentina (unpublished).

3. Below „*Morphoceras*" beds

790401/4b, c — Several incomplete *Sonninia* (*Papilliceras*) cf. *espinazitensis* TORNQ. and *S.* (*P.*) sp. indet., 1 *Emileia* sp. indet. juv., and 1 minute phylloceratid. This fauna is well known from the Lower Bajocian Giebeli Zone of the Central and Southern Andes (WESTERMANN & RICCARDI, 1972).

790401/4a — One small fragment of *Sonninia* s.lato sp.indet.; 1 deformed and incomplete *Pseudotoites* gr. *transatlanticus* (TORNQ.) - *argentinus* ARKELL ♀ [macroconch]. These species are well known from the Lower Bajocian Singularis and lower Giebeli Zones (Submicrostoma Subzone) of the Central and Southern Andes (WESTERMANN & RICCARDI, 1978).

4. Below 4a, b, c

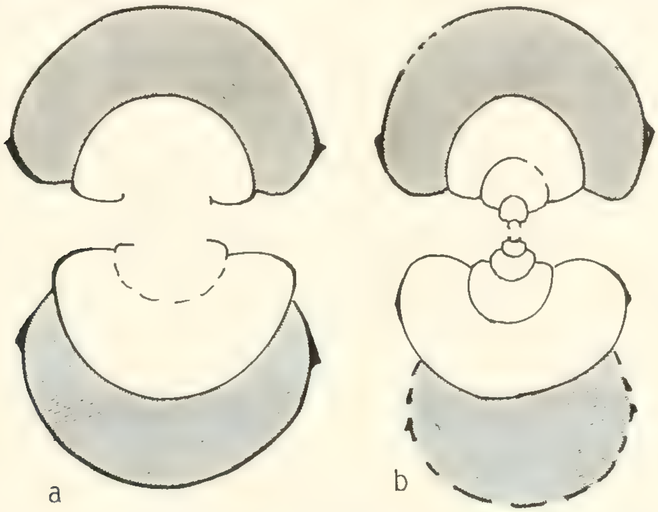
790401/3 — One fragment of *Sonninia* (*Papilliceras*) cf. *espinazitensis* TORNQ. subsp. *altecostata* TORNQ. ?; 1 fragment of ?*Pseudotoites* sp. indet. *S. espinazitensis* s. stricto is known from the Giebeli Zone of the Andes, whereas *S. e. altecostata* would indicate the Andean Singularis Zone (WESTERMANN & RICCARDI, 1972).

Taxonomy

(?)Superfamily Perisphinctaceae STEINMANN, 1890
(?)Family Morphoceratidae HYATT, 1900
Genus nov. et sp. nov.

Description

The two, complete specimens came from bed 790401/5 in the upper Socosani Formation at Quebrada de Quentos, approximately 5 km NW of Cincha, Arequipa Province (Plate 1, figs. 1, 2). One specimen was found by Dr. JEAN-CLAUDE VICENTE, formerly Departamento de Geología, Universidad Nacional de San Augustin, Arequipa; the other by one of us (A. v. H.). The preservation is modest, in black, tuffaceous mudstone, mostly as internal moulds and with recrystallized septate whorls.



Text-fig. 2. Whorl cross-sections of (?)Morphoceratidae n. gen et sp.; a, free-hand drawing of B.St.M. 1995 I 27; b, drawn from photograph of B.St.M. 1995 I 28 after cross-cutting; both natural size. Note that (a) is more depressed throughout and that the two specimens may not be conspecific, although superficial resemblance is close.

Complete diameter is about 70 mm. The juvenile whorls up to about 25 mm diameter, visible only in the cross-section of the second specimen (Text-fig. 2b), are moderately evolute and somewhat compressed. The subsequent whorls become rapidly more involute and depressed, so that the complete phragmocone (c. 40 mm D) is globular. At 30 mm diameter, the whorl-section of specimen BSP 1995 I 27 is hemicircular with very steep umbilical wall that probably bears blunt primaries (pl. 1, fig. 1 c, d). The sharp umbilical edge has fine, bullate tubercles, in which the dense secondary costae arise, usually in pairs; additional single secondaries are intercalated in some distance from the bullae. The costae pass streight across the venter, without interruption of weakening. The quarter-whorl exposed has two continuous constrictions that are moderately inclined forward. On the last septate half-whorl, the umbilical wall and edge become progressively rounded and the primary costae more prominent. The inner whorls of the topotype are somewhat narrower and less depressed, with more rounded umbilical slope (Text-fig. 2 b).

The body-chamber, 3/5 to 3/4 whorl long, egresses moderately and gently (U/D= 0.15 to 0.25) and the whorl becomes rounded by cessation of width growth (negative allometry). Costal division moves from near the umbilicus to about 1/3 whorl-height, dominantly with dichotomy in small, bullate tubercles; intercalatories are rare. The aperture is obliquely projected, with lateral constrictions and a ventral projection with superficial lip, as seen on a thick shell remnant. Septa and sutures are poorly known.

Comments

T a x o n o m y o f M o r p h o c e r a t i d a e – Although the morphoceratids have most commonly been classified in the perisphinctaceans, presumably because of the presence of the tell-tale constrictions (e.g., DONOVAN et al., 1981), there are notable exceptions. Ontogenetic studies of the septal suture have established the presence of a dorsal Un lobe, as present in the Stephanocerataceae but absent in the Persphinctaceae (SCHINDEWOLF, 1965); and there appear to exist transitional forms to *Orthogarantiana* (SANDOVAL, 1983), presumable a member of the Garantianinae that are commonly placed in the Stephanoceratidae (DONOVAN et al., 1981). However, according to WESTERMANN (1956), the Un lobe is absent in *Garantiana*, but present in *Parkinsonia* of the Parkinsoniidae, placed in the Perisphinctaceae by DONOVAN et al. (1981). Thus sutural ontogeny contradicts former and current taxonomies of the mentioned Late Bajocian possible ancestors of the morphoceratids and that their origin, and their superfamilial classification remains ambivalent. We follow here, somewhat tentatively, the systematics of DONOVAN et al. (1981) by stressing the presence of the characteristic constrictions.

Morphoceratidae evolution has recently been summarized by SANDOVAL (1983). All species are strongly dimorphic, with minute, rather evolute microconchs bearing large lappets, and much larger, commonly involute macroconchs with uncoiling and contracting bodychamber. Morphoceratids are also characterized by irregularly costal bundling (fasciculation) in bullae or small elongated tubercles on the umbilical margin (or lateral edge) (ARKELL, 1955), even in the more evolute genus *Asphinctites* (WESTERMANN, 1958, plate 46, figs. 2a–c). The first, Mid-Late Bajocian forms, *Dimorphinites*, has obvolute adult septate whorls in the macroconch and very finely costate, much more evolute microconchs, e.g., *D. defrancei* (d'ORB.) (SANDOVAL, 1983, plate 27, fig. 15). According to SANDOVAL (1983), the clade splits in the earliest Bathonian. (1) The *Morphoceras* - *M.* (*Ebrayiceras*) dimorphic pair, with moderately involute, adult macroconchs that bear costae bundels in the form of bullae on the sharp umbilical edge, and the more evolute and coarsely costate microconchs; both dimorphs have a ventral smooth band by costal interruption. And (2) the mainly late-Early Bathonian dimorphic pair *Asphinctites* - *A.* (*?Polysphinctites*) is more evolute and with continuous costae, i.e., without the ventral smooth band so characteristic, but by no means diagnostic, for morphoceratids. However, morphically somewhat intermediate form between *Morphoceras* and *Asphinctites* existed in *A. pinguis* (DE GROSS.) and *A. replictum* (BUCK.) (originally classified as *Polysphinctes* !). They have the more involute and inflated septate whorls of the former, but the continuous costae and commonly few constrictions of the latter (cf. BUCKMAN, 1922, plate 359; ARKELL, 1955, plate 16, figs. 9, 10; STURANI, 1967, text-fig. 3a, b; MANGOLD, 1970, plate 3, figs. 13, 14; SANDOVAL, 1983, plate 28, fig. 5).

Morphoceratidae have been known almost exclusively from western Europe, except for the single *Asphinctites* cf. *pinguis* (DE GROSS.) found by WESTERMANN in the old Utrecht collections that were collected in 1902 from talus at „Keeuw" on the Sula Islands, eastern Indonesia (WESTERMANN & CALLOMON, 1988).

C o m p a r i s o n – The intermediate whorls resemble *Morphoceras* macroconchs ♀, but the outer whorls are most like in the inflated, Early Callovian *Macrocephalites* microconch ?„*Kamptocephalites*" BUCKMAN. Thus, before the inner whorls were exposed, specimen had been mis-identified by J. C. VICENTE as „M. (*Kamptokephalites*) aff. *kamptus* BUCKMAN", a microconch from the Lower Callovian of western Europe. Superficial resemblance also exists to the western Pacific, Upper Bajocian Lower Bathonian sphaeroceratids *Praetulites* WEST. and *Satoceras* WEST. & CALLOMON, the cosmopolitan, Early Bajocian otoitid microconch *Otoites* MASCKE, and to the west-European, Mid-Bathonian, small tulitid microconch *Sphaeroptychius* LISSAJOUS. All are distinguished from our Peruvian form by the absence of constrictions as well as other features. The mentioned taxa thus almost certainly represent convergent shapes within quite unrelated clades. The Tulitidae are of special interest here because of their relative abundance in the Upper Bathonian of adjacent northern Chile (cf. RICCARDI et al., 1992). The rare *Tulites* microconch *Trolliceras* TORRENS („*Krumbeckia*" ARKELL) and the *Morrisiceras* microconch *Holzbergia* TORRENS – by inference also the poorly known juvenile macroconchs (see ARKELL, 1951, plate 2, fig. 4) – have similarly sharp umbilical edges bearing tubercles, but their whorls are much more evolute and compressed („planulate") than in immature Peruvian „*Morphoceras*" (cf. ARKELL, 1951, plate 2; TORRENS, 1970, plate 36). (Note that in proper nomenclature, all of these microconchiate „genera" are junior synonyms of the corresponding macroconch genera.) The best match to juvenile „*Morphoceras*" is the rare European *Sphaeroptychius* (includes *Schwandorfia* ARKELL), which also has highly inflated septate whorls and a steep umbilical slope with sharp umbilical edge bearing bullae or costal fasciculations (cf. ARKELL, 1951, plate 1, figs. 9, 10; KRYSTYN, 1972, plate 24, figs. 2, 5, 6; SANDOVAL, 1983, plate 71, fig. 3). *Sphaeroptychius*, however, is usually considered as an aberrant microconch of *Bullatimorphites*, although all known juvenile whorls of *Bullatimorphites* s. lato (including *Kheraiceras*) have well rounded umbilical slopes without nodes or fasciculations.

The intermediate whorls (25–30 mm diameter), exposed only in specimen B.St.M. 1995 I 27, are a good match to the adult septate whorls of macroconchiate *Morphoceras* and, especially, inflated species of *Asphinctites*. Globular variants of *Morphoceras multiforme* ARKELL, a common form in the basal Bathonian (Convergens Zone/Subzone of Zigzag Zone) of Europe, differ only in the presence of a ventral smooth band (cf. ARKELL, 1955, Text-figs. 47, 50 and plate 51, figs. 1, 2; STURANI, 1967, plate 9, figs. 6a, b; SANDOVAL, 1983, plate 27, fig. 14). Both have also the irregularly bundling costae with bullae on the sharp umbilical edge, a character shared by all morphoceratids, even by those without the highly variable costal interruption at mid-venter (ARKELL, 1955). *Asphinctites*, the last morphoceratid genus known from Europe (upper Lower Bathonian, Yeovilensis and Tenuiplicatus Zones/ Subzones of Zigzag Zone) and eastern Indonesia (age unknown, cf. WESTERMANN & CALLOMON, 1988, plate 18, figs. 4a,b), agrees with the Peruvian form also in the secondary costae that are consistantly continuous across the venter, but it tends to be more evolute and with fewer constrictions than in *Morphoceras*. The best match to the intermediate whorls of the Peruvian form is the most inflated species of *Asphinctites*, *A. pinguis* (DE GROSSOUVRE) as illustrated from western Europe (cf. ARKELL, 1955, text-fig. 49; STURANI, 1967, text-figs. 3a, b; SANDOVAL, 1983, plate 28, fig. 5; TORRENS, 1987, plate 2, figs. 1–4) and, probably, eastern Indonesia (cf. WESTERMANN & CALLOMON, 1988, plate 18, figs. 4a, b).

The body-chamber of all morphoceratids described previously becomes characteristically evolute, commonly with elliptical coiling (cf. *Asphinctites pinguis* in STURANI, 1967, text-fig. 3a, b; TORRENS, plate 2, figs. 3, 4) and contraction. Ornamentation becomes subdued, especially on the flanks that tend to become smooth. In contrast, the body-chamber of the Peruvian form egresses only moderately and the ornamentation becomes more prominent over the entire whorl, including lateral nodes. The complete shape is thus much more inflated than any other fully grown morphoceratids.

Phylogeny – The Peruvian n. gen. et sp. is tentatively interpreted as a late member of the Morphoceratidae that survived endemically in the southeastern Pacific („refuge", cf. WESTERMANN, 1993), and that either was descended palingenetically from *Asphinctites*, or evolved directly and in parallel with *Asphinctites* from *Morphoceras*.

Measurements (mm)

	D	Ww	Wh	U	P	S
BSP 1995 I 27						
aperture	67	36	24.5	16.5	10	23
end phrag.	39	38	20.1	c.6	c.12	c.30
phrag.	29.5	23.5	14	c.7.2	11–12	c.30
BSP 1995 I 28						
aperture	c.70	32.5	22	15.7	9	20
end phrag.	38	32	19.5	5	–	–
phrag.	31.6	19.3	15.1	8.2	–	–
phrag.	23	12.1	9.3	7.0	–	–
phrag.	17.4	9.3	7.6	5.1	–	–

(Abbreviations: D = diameter; Ww = whorl-width, Wh = whorl-height, U = umbilical diameter, P = primary costae or bullae per half-whorl, S = secondary costae per half-whorl; apert. = aperture, phrag.= phragmocone)

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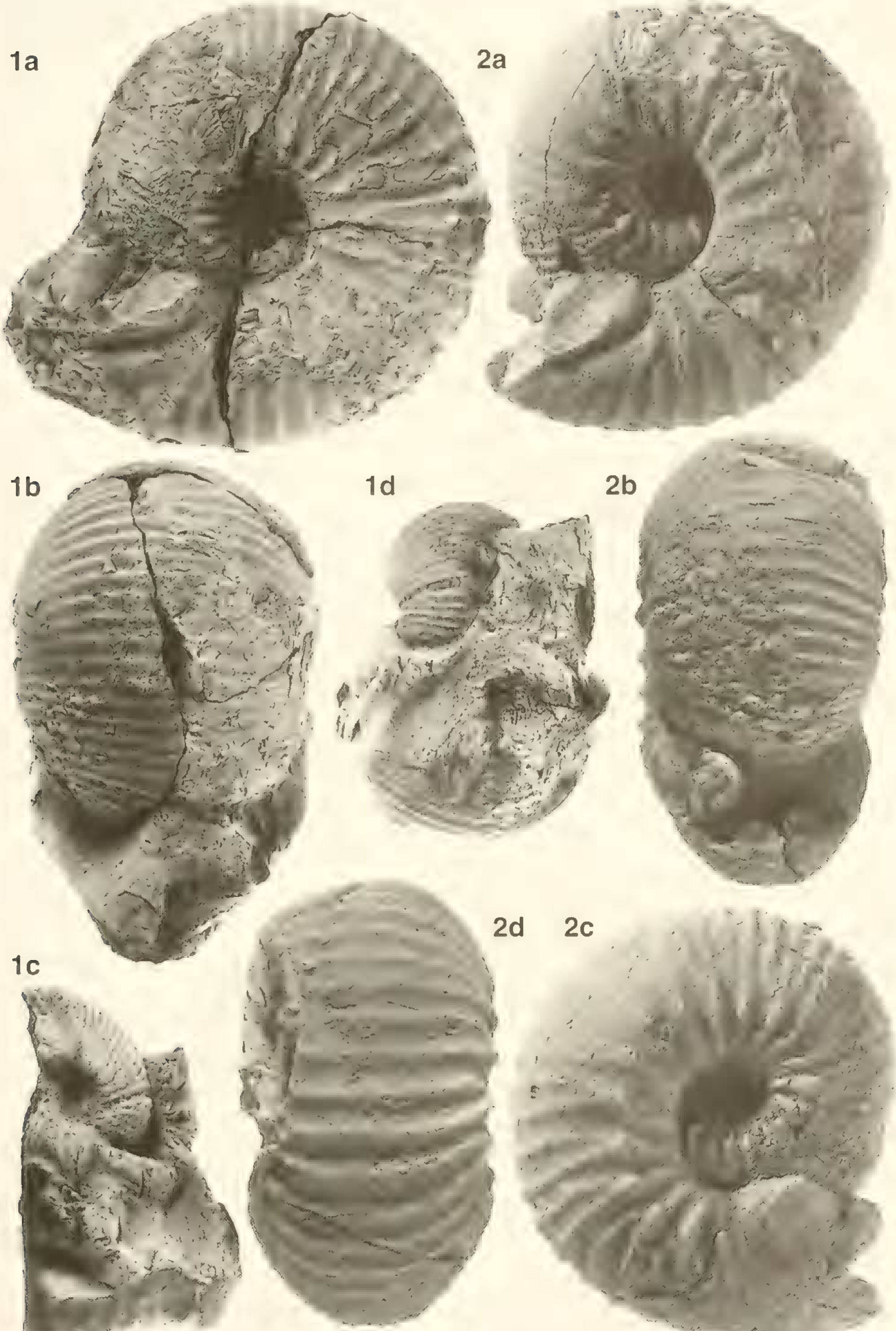
Plate 1

Figs. 1, 2. (?) Morphoceratidae n. gen. et sp., from locality 790401/5, Quebrada de Quentos, Arequipa area, south Peru. 1a–d, BSP 1995 I 27, complete with partially developed inner whorls; 2a-d, same locality, BSP 1995 I 28 (before sawn in median plane, cf. text-fig. 2). Note that the second specimen is not necessarily co-specific with the first: its inner whorls are poorly known.



Gerd E. G. Westermann & Axel v. Hillebrandt: Morphoceratidae   **Tafel 1**